



Electromagnetic vaccination

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ABSTRACT

Numerous reports indicate robust mitogenic responses in human lymphocytes to low-frequency electromagnetic fields. We hypothesize that these observations reflect a wider platform for immune capability than presently recognized, whereby weak electromagnetic signals play the role of antigens. This notion hinges on whether pathogenic bacteria can emit correspondingly detectable electromagnetic signals. We make this case, recalling pertinent experimental evidence by Pohl and others implicating signal emission during cell replication due to rapid electric charge redistribution. If correct, this hypothesis would also offer a new approach to the coupled problems of hospital-acquired infections and rapid adaptations to antibacterial agents, suggesting the possible treatment of patients at risk using an electromagnetic vaccination procedure. Under the reasonable assumption that signals arising from diverse bacterial varieties can be separately catalogued, prophylaxis would be achieved by prior exposure of patients to electromagnetic signatures from high-morbidity sources. Among its potential advantages such treatment would be non-invasive, inexpensive, rapidly deployed, and conceivably, less likely to lose effectiveness over time due to bacterial adaptation.

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Introduction

Contrary to mid-20th century expectations, bacterial infectious diseases have proven increasingly intractable. There are approximately 500,000 cases of pneumococcal pneumonia in the US annually, and it has been estimated that globally, almost two million children under age 4 succumb to this infection yearly [1]. Many hospitals encounter nosocomial infections of *Staphylococcus aureus*, especially in its more recent, methicillin-resistant *S. aureus*, MRSA variant. There has also been increasing resistance of *Streptococcus pneumoniae* to penicillin and macrolide therapies [2], and the ominous emergence of other multi drug-resistant strains, sometimes referred to as “superbugs” [3,4].

In the following, we suggest a new approach to this growing problem, developing the novel concept that the capabilities of the immune system extend beyond its presently well-recognized functions, to also include an electromagnetic response.

Such response is consistent with numerous well-documented reports indicating effects of low-frequency magnetic fields on both B- and T-lymphocytes, in some cases at remarkably weak magnetic field intensities [5–11]. These reports alone do not provide sufficient reason to believe there may be an electromagnetic component to the immune response. One must also demonstrate that pathogens, through electromagnetic emission, are recognized as

such by magnetosensitive lymphocytes. If bacteria do indeed emit detectable electromagnetic signals, one can anticipate the likelihood that the immune system recognizes such signals as antigens, no less effectively than it does biochemically, perhaps even to the degree where antigenic specificity is determined in terms of frequency recognition.

Pathogens as electromagnetic sources

In this connection arguments have once again surfaced in support of homeopathic medicine, this time following observations by Montagnier [12] that low-frequency electromagnetic signals appear to emanate from bacterial suspensions. Although we withhold comment on the homeopathic implications there are other aspects of this contentious work that may have medical consequences.

We note that there is a provenance for electromagnetic radiation from cells, first reported by Pohl [13,14]. This work followed earlier bioelectric studies by Lund [15] hinting at electric dipole-like charge separations in plant cells and later by Jaffe [16] showing ion current distributions consistent with Lund's results surrounding developing plant, insect and animal cells. This large body of work remains uncontested, and the many consequent clues strongly suggesting cellular electromagnetic emission remain unexplored.

Among the claims by Montagnier [12] is that DNA was the source of the observed radiation. However, it seems unlikely that DNA in its resting state could generate such emission, which at a

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minimum requires rapid charge displacement and continuing energy replenishment. A more credible source, still involving DNA, would be the charge displacement that likely occurs during strand separation or the DNA redistribution prior to binary fission.

There also may be considerable charge separation in non-DNA cellular regions. The process of division may itself be the reason for the reported electromagnetic radiation, with the signal arising from a redistribution of charge density. The cytosolic force that results in binary fission is supplied by a constricting ring (Z-ring [17]) comprised of proteins homologous to eukaryotic tubulin. Given the similarity to tubulin, which enjoys an extraordinary array of electric properties dependent on charge transfer [18,19], it is difficult to imagine the corresponding bacterial proteins providing the pinch-off force of division without also causing a considerable displacement of electric charge.

Cellular entities that enjoy charge dipole distributions to begin with will undergo radical redistributions of electric charge during fission necessitated by the formation of two new daughter cells, each perhaps with its own dipole charge separation. Such changes could result in the generation of local currents leading to magnetic fields. One can then argue that cells when dividing will necessarily radiate in the course of creating two new dipole moments.

Therefore there are a number of credible possible sources for electromagnetic signals from cells. The emission in question may not only be the consequence of electric changes occurring at the DNA molecule during replication, but could also result from the more pervasive morphological changes in the entire cell occurring during division. In any event it is clear that there exist interesting possibilities for electromagnetic emissions from bacteria.

Consider further the distinct possibility that if the reported bacterial electromagnetic emission is real, the phenomenon will also be frequency specific, such that there is a different spectral distribution for each type of bacteria. This is not altogether unreasonable, considering the different charge distributions that can reflect different bacteriological morphologies. This possibility would carry no small clinical significance, in that such frequency specificity would likely be reflected in a truly novel immune response.

The hypothesis

Accordingly, we hypothesize that electromagnetic signals arising from given infectious sources can be catalogued for future reference by the immune system, much in the way that debilitating biochemical signals are catalogued by the immune system. This novel concept is consistent with the ability of living systems in the course of natural selection to develop immune protection mechanisms against external threats that can be measured and dealt with in physically specific terms. In a larger sense, the recognition and response to certain electromagnetic frequencies may present less of a problem from an evolutionary perspective than the recognition and response to specific biomolecules.

This suggests, in close analogy to the long-standing vaccination process, that a new type of electromagnetic vaccination may be feasible. Bacterially specific frequencies applied to the body externally prior to exposure could serve as prophylaxis against eventual infection. In practical clinical terms this might involve examining the output frequencies associated with, say, cultures of Staph or MRSA, and applying these frequencies to patients in danger of infection.

In suggesting that local electromagnetic signals could serve as antigens, the question immediately arises as to how immune cells might recognize purely electromagnetic signals, using these to trigger the release of antibodies. This question is readily addressed by the large earlier body of work [5–11] establishing the response of human lymphocytes to low-frequency magnetic fields. These

well-documented effects include altered proliferative response to mitogens as well as changes in calcium uptake and signal transduction, excellent reasons to believe that immune system cells may include electromagnetic signals in their repertoire of antigen-recognizing mechanisms. More recent studies [20–23] have now greatly reinforced this conclusion, determining among other things that chromatin conformation in human lymphocytes is sharply affected by exposure to weak low-frequency magnetic fields.¹

In summary, the concept we are proposing is that the immune system recognizes and responds to radiating infectious bacteria through cells that are sensitive to such signals, and that discrimination by the immune system is made possible by frequency distributions specific to different bacterial types. In this context one can anticipate the feasibility of electromagnetically vaccinating patients at risk, i.e., exposing them to the specific signals that are known to be emitted by pathogenic bacteria.

Evaluation

Even if bacteria do radiate characteristic signals, the detectability of such events is quite another matter, given the limited amount of energy available for radiation from a single cell. Signal strength will be dependent first on the speed of the charge redistribution that must accompany the formation of the two daughters and also the degree to which the intensity of the emitted signal is in excess of that generated by background noise. The faster the fission-dependent redistribution of charge, the more likely that higher frequencies will be observed. By contrast, the intensity, or strength of the antigen-like signal will depend on the current that is generated, in effect the total amount and rate of change of displaced charge.

There is a means to distinguish the intensity of the hypothesized cellular emission from that of the ever-present thermal bath of background signals. One can make use of the original assumption by Pohl that the radiation he reported was related to the fission process. If true, the strength of whatever signal is observed would be expected to also scale with the number of cell divisions occurring simultaneously. A definitive experiment is therefore suggested, one that examines the signals emanating from a well-characterized bacterial culture in synchrony. If the radiation intensity turns out to be greater for samples that are synchronously prepared as compared to those that are not, this result would provide strong evidence connecting the source of the radiation to the replication process *per se* or to some other periodic event intrinsic to the cell cycle.

Discussion

One might also attempt to associate emissions with cellular oscillations, a well-recognized phenomenon [24] found in diverse cell types, often appearing as adjuncts to calcium waves [25]. Such oscillations are necessarily accompanied by magnetic fields. However, it is difficult to make the case that these oscillations, including those in bacteria [26], act antigenically, because the measured frequencies in these reports are one or two orders of magnitude below 1 Hz, and therefore incommensurate with the much higher emission frequencies reported [12], approximately 7 Hz.

To implement electromagnetic vaccination procedures in a medical setting would be relatively simple and inexpensive. It

¹ As an interesting aside it is highly likely that the motivation for the work referred to in Refs. [5–11] and [17–23] was the great interest surrounding potential hazards arising from electromagnetic exposures to low-frequency magnetic fields due to power transmission. Should electromagnetic vaccination prove viable, it would greatly reinforce the notion that science feeds on serendipity.

would be non-invasive, only requiring applications of low-frequency magnetic fields, with no associated sensation. The literature clearly indicates that quite small field intensities are needed to interact with lymphocytes, implying that minimal energy would be needed to achieve antigen recognition.

The question of bactericidal adaptation is especially interesting in the context of the present hypothesis. Bactericides work to alter specific biochemical processes in the bacterium by binding to specific meaningful targets, hopefully promoting rupture of the bacterial walls. However, a number of subsequent factors can occur that may confound this action, for example, the presence of mutants that genetically lack the target or its downstream importance.

In sharp contrast, it can be argued that this type of bactericidal resistance would not occur as an impediment to immune protection in processes governed by signals radiated by bacteria. The intrinsic nature of these signals might not necessarily be changed in the same way as happens in the internal molecular adaptations that occur in the resistance to anti-bacterial agents. If, for example, the emissions in question result from cell-sized morphological changes, then the sort of antibacterial resistance arguments based on limited pathways involving finer molecular events will not apply. In short, electromagnetic vaccination might provide a means of avoiding the growing problem of bactericidal resistance.

If the source of the radiation is indeed charge transfer during DNA strand separation, or some closely-related process, then one might expect smaller differences among different types of the infectious agents. However if the causative charge transfer instead encompasses much larger regions of the cell, then the resulting emission will be very dependent on cellular morphology. Large differences would therefore be expected, for example, in the output signals of *S. aureus*, which is globular, and *Escherichia coli*, which is rodlike. It goes without saying that there may be obvious extensions of this concept to non-bacterial pathogens.

Conflict of interest statement

There is no direct or indirect conflict of interest, monetary or otherwise, regarding my authorship of this work. I bear sole responsibility for it, with no collaborators, either acknowledged or not.

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